## REMARKS

As the Examiner is aware, applicant's invention is directed to the final finished polycrystalline alumina arc tube which has certain measurable characteristics that have been defined specifically in our claims. Thus, features such as the magnesium oxide being 200 ppm or below, a tube wall loading value of $Wcm^2$, the distance between the electrodes EL and an inner diameter of the main tube part Di are defined in our main independent Claims 1 and 6.

Additionally, an average crystal grain diameter of the polycrystalline alumina ceramic tube is defined within the following range: $0.5 \leq G \leq 1.5$.

By adjusting the crystal grain diameter in the polycrystalline alumina ceramic tube, cracks are effectively restrained even when the arc tube is subject to thermo shocks that can be a specific problem in a relatively thin or slim arc tubes.

Our specification specifically defines the claimed crystal grain diameter as follows:

> In addition, "crystal grain diameter" used in the present description means an average crystal grain diameter for polycrystalline alumina ceramic grains. A concrete calculation method is detailed later.
>
> Furthermore, it is preferable that the crystal gain diameter G(μm) of the polycrystalline alumina ceramic satisfies $0.5 \leq G \leq 1.5$. Page 4, Lines 4-11
>
> * * *
>
> Here, the crystal grain diameter was calculated by measuring the number of crystals per a unit length, and by dividing the unit length by the number of crystals. Page 21, Lines 18-21

As can be determined, we are dealing in our claims not with simply alumina powder which is utilized to pre-form an initial shape of the arc tube as one component, but rather we are claiming the crystal grain diameter, which is the result of the white alumina powder being sintered at a high predetermined temperature so that it is crystallized and translucent for the

purposes of providing a transmittance of 94% or higher, as defined in our specification on Page 15, Lines 2-10 as follows:

> The alumina powders, being originally white, are crystallized by being sintered. As a result, sintering of translucent polycrystalline alumina ceramic, in which crystallographic axes have different directions from each other, competes. It is possible to obtain polycrystalline alumina ceramic having a desired grain diameter by adjusting a grain diameter of the alumina powders, a sintering temperature, and a sintering time.

The reference *Oda* merely discloses that the average particle size of the alumina powder is "not more than 1 μm, preferably 0.1 μm" and does not teach that the average crystal grain diameter of the sintered polycrystalline alumina ceramic in the translucent arc tube is 1 μm (Column 2, lines 1-3).

Alumina power is white in a powdery state before sintering. However, when sintered to form a ceramic tube, crystal grains are formed and the diameters increase as a result of the sintering, due to the crystallization of the alumina powder to a translucent crystal grain.

*Oda et al.* discloses that an average grain diameter of its sintered polycrystalline alumina ceramic (i.e. the average crystalline grain diameter G of the present invention) is limited to a range from 20 μm to 60 μm (Claim 1 and Column 2, lines 18-24 of the reference *Oda et al*). A reason for this limitation is stated in the reference *Oda et al.* as follows:

> "When the average crystal grain size is less than 20 μm, the mechanical strength is improved, but the light transmission properties are deteriorated. While, when the average crystal grain size exceeds 60 μm; there is not a problem relating to the light transmission properties, but the mechanical strength is deteriorated." Therefore, the average crystal gain size of the polycrystalline transparent alumina should be limited to a range of 20 to 60 μm. (Column 2, lines 24-32).

Therefore, unlike Claim 1 of the present Application, the reference *Oda* does not disclose nor suggest that the average crystal grain diameter G of the sintered polycrystalline alumina ceramic is as small as 0.5 μm ≤G≤1.5 μm.

In fact, as noted above, *Oda et al.* actually prefers alumina powder with <u>a particle size</u> of 0.1μm below our range of average <u>crystal gain size</u> of 0.5 μm.

The Office Action specifically contended that the terminology "sintering" was not germane as a method limitation in the manufacturing of polycrystalline alumina. Applicant respectfully notes that "sintering" indicates that an alumina powder has been changed from a white color to a crystalline translucent configuration in a ceramic and for that reason, applicant utilizes the terminology "sintered" not for the uniqueness of the manufacturing step, but for the resulting end product being a translucent ceramic.

The Office Action correctly notes that the alumina is sintered in *Oda et al.* to produce a ceramic tube but mistakenly states that *Oda et al.* discloses "the correct average grain diameter."

Our inventors purposely sought to achieve a smaller diameter of a crystal grain then the conventional crystal grain diameters of 15 μm to 40 μm, which is suggested by *Oda et al.* In this regard, our inventors restrained any abnormal grain growth in the sintering process and provided a translucent ceramic arc tube with a specific average grain diameter that addressed thermal shock problems in small arc tubes while providing necessary light transmittance.

Since the reference *Oda et al.* discloses that the amount of the MgO to be added is 0.01 to 0.2% by weight and this range partially overlaps the range "200 ppm or below" of the present Application, the Examiner may have thought that the reference *Oda et al.* also makes it possible to obtain an average crystalline grain diameter that is within a range that is similar to the range disclosed in Claims 1 and 6 of the present invention.

However, as disclosed in Column 2, Lines 14-24, the average crystalline grain diameter is easily influenced by the type of added substances and the sintering conditions.

> Moreover, the average crystal gain size of the polycrystalline transparent alumina is considerably influenced by the particle size distribution of the alumina powder starting material, kinds and amounts of additives used, sintering conditions and the like. By optionally selecting a combination of these factors, the average crystal grain size of the resulting polycrystalline transparent alumina may be limited to a defined range (20-60 μm) and the crystal grains of the particular size (20 μm or less) may be adjusted to an amount of not more than a defined ratio (30%) per unit area.

*Oda et al.*, discloses in its Example at Column 2, Lines 47-48, that $La_20_2$ and $Y_20_3$ are added in addition to the MgO. The reference *Oda et al.* teaches that a combination of such conditions is selected to adjust the average crystalline grain diameter of the sintered polycrystalline alumina ceramic to be within the range from 20 μm to 60 μm.

Thus, according to *Oda et al.*, even if the added MgO is of "200 ppm or below," it is necessary to further add a prescribed amount of additives to adjust the average crystalline grain diameter of the sintered polycrystalline alumina ceramic to be within its desired range of 20 μm to 60 μm. *Oda et al.* teaches away from our Claims 1 and 6 of the present Application.

The present invention, pertaining to the claim of the present Application, is characterized by (a) the values " WL" and "EL/Di" meeting prescribed conditions, (b) the average crystal grain diameter G of the sintered polycrystalline alumina ceramic being $0.5\ \mu m \leq G \leq 1.5\ \mu m$, and (c) MgO of 200 ppm or below being present. As a result, our present invention can provide a metal halide lamp that can limit cracking caused by thermal shock, achieve a high translucency (luminous flux maintenance factor) and provide a long life.

Cracking is effectively prevented by adjusting the average crystal grain diameter of the polycrystalline alumina ceramic to our claimed range (see Figures 4 and 5), and the luminous flux maintenance factor of the arc tube depends on the amount of the added MgO (see Figure 3).

In *Oda et al.*, it is necessary to adjust the average crystalline grain diameter to be 20 μm to 60 μm to achieve a good balance between a high mechanical strength and a high translucency. A person of ordinary skill in the art would not be motivated by the reference *Oda et al.* to alter the average crystalline grain diameter, to change the taught average crystalline grain diameter (20μm) to be 0.5 μm to 1.5 μm as disclosed by Claims 1 and 6 of the present Application, because the reference *Oda et al.* states that its desired effect can not be achieved if the average grain diameter is smaller than 20 μm.

The other claims are dependant from Claim 1 or Claim 6 and further limit the base claims respectively.

The *Keijser et al.* (U.S. Patent No. 6,300,729) was cited for a general structure of a tube and for a teaching of a tube wall loading factor, the distance between electrodes and an inner diameter of a main tube. It did not address the factors mentioned above with regards to polycrystalline average grain diameter.

Our recent discussion with Pinchus Laufer in the Office of Patent Legal Administration, who was involved in writing the Examination Guidelines for Determining Obviousness under 35 USC §103 in view of the Supreme Court decision in *KSR International Co. vs. Teleflex, Inc.* verified that the KSR decision still required a specific rationale that could not be based on hindsight for purportedly combining the elements in the prior art to meet an invention defined in the patent claims.

Mr. Laufer incorporated the following from the existing MPEP into the Guidelines.

As noted in the MPEP at §2143.02:

> A rationale to support a conclusion that a claim would have been obvious is that all the claimed elements were known in the prior art and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions, and the combination would have yielded nothing more than predictable results to one of ordinary skill in the art. *KSR International Co. v. Teleflex Inc.*, 550 U.S. ___, ___, 82 USPQ2d 1385, 1395 (2007); *Sakraida v. AG Pro, Inc.*, 425 U.S. 273, 282, 189 USPQ 449, 453 (1976); *Anderson's-Black Rock, Inc. v. Pavement Salvage Co.*, 396 U.S. 57, 62-63, 163 USPQ 673, 675 (1969); *Great Atlantic & P. Tea Co. v. Supermarket Equipment Corp.*, 340 U.S. 147, 152, 87 USPQ 303, 306 (1950). (underline added)

Assuming no change in the function of the *Keijser et al.* reference and modifying the *Keijser et al.* reference to include the function of the *Oda et al.* teaching, a person of ordinary skill in this art would be instructed to provide an average crystal grain size greater than 20 μm. There is no rationale that would be credible to a person of ordinary skill in this art, that would permit a person to take alumina powder of a white configuration and an average particle size, preferably of less than .1 μm and equate it to an average crystal grain diameter in the finished sintered polycrystalline alumina ceramic arc tube of our present invention.

To further reinforce the concept that we are claiming an average crystal grain diameter in the translucent polycrystalline alumina ceramic arc tube, new Claim 12 is provided as an independent claim and defines specifically the calculation of determining in the ceramic arc tube the average crystal grain diameter. Additionally, Claims 10 and 11 depend from the independent Claims 1 and 6 and further add these features.

It is believed that the present invention has been adequately defined over that of the cited art and an early indication of allowability is respectfully requested.

If the Examiner believes that a telephone interview will assist in the prosecution of this matter, the undersigned attorney can be contacted at the listed phone number.

Very truly yours,

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